United States
Department of
Agriculture

Economic
Research
Service

Economic
Research
Report
Number 104

October 2010

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USDA
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Abstract

Based on 2 days of dietary data and panel data methods, this study includes estimates of how each child's consumption of food away from home, food from school (which includes all foods available for purchase at schools, not only those offered as part of USDA reimbursable meals), and caloric sweetened beverages affects that child's diet quality and calorie consumption. Compared with meals and snacks prepared at home, food prepared away from home increases caloric intake of children, especially older children. Each food-away-from-home meal adds 108 more calories to daily total intake among children ages 13-18 than a snack or meal from home; all food from school is estimated to add 145 more calories. Both food away from home and all food from school also lower the daily diet quality of older children (as measured by the 2005 Healthy Eating Index). Among younger children, who are more likely than older children to eat a USDA school meal and face a more healthful school food environment, the effect of food from school on caloric intake and diet quality does not differ significantly from that of food from home.

Keywords: Food away from home (FAFH), food from school (FFS), caloric sweetened beverages (CSB), children's diet quality, 2005 Healthy Eating Index (HEI-2005), fixed effects, first difference, Continuing Survey of Food Intakes by Individuals (CSFII), National Health and Nutrition Examination Survey (NHANES), ERS, USDA

Acknowledgments

The authors thank the following reviewers for their insightful suggestions and comments: Ronette Briefel (Mathematica Policy Research), Hayden Stewart (USDA, Economic Research Service (ERS)), Mary Story (Division of Epidemiology and Community Health at the University of Minnesota), and Steven Carlson and Jay Hirschman (USDA, Food and Nutrition Service). John Weber and Cynthia A. Ray of ERS provided editorial and design assistance.

Contents

Recommended citation format for this publication:

Mancino, Lisa, Jessica E. Todd, Joanne Guthrie, and Biing-Hwan Lin. *How Food Away From Home Affects Children's Diet Quality*. ERR-104. U.S. Dept. of Agriculture, Econ. Res. Serv. October 2010.

Summary

In recent decades, more and more American children have become overweight, and most now eat a low-quality diet—consuming too much calorie-dense, low-nutrient foods and too little fruits, vegetables, whole grains, and milk. Increased consumption of foods prepared outside the home has been identified as a possible cause of rising rates of obesity and poor diet quality.

What is the issue?

Among children ages 6-18, away-from-home foods are most likely to come from fast food outlets, restaurants, and schools. Increased consumption of such foods may be a cause of overweight, or it may just be correlated with other factors that increase risk of overweight, such as individual food preferences and access to myriad food outlets. Consumption of caloric sweetened beverages, which is associated with both overweight and eating out, may contribute to the effects of away-from-home foods on caloric intake and diet quality. In this study, previous research is advanced through an examination of the effects of both commercially prepared food away from home and all food from school on the diets of children, where all food from school includes foods available for purchase at schools, not only those offered as part of USDA reimbursable meals. Also, researchers separate the effects of caloric sweetened beverage consumption from the effects of away-from-home meals. The results may help to inform obesity prevention policies and strategies.

What are the findings?

Food obtained from fast food outlets, restaurants, and other commercial sources is associated with increased caloric intake and lower diet quality, as measured by the Healthy Eating Index (HEI), especially among children ages 13-18. These effects hold after employing a methodology that controls for the impacts of underlying personal characteristics and circumstances, such as access to food outlets, which might also affect food choices. This finding strengthens the argument that there is a causal relationship between food away from home and both increased caloric consumption and decreased dietary quality. It also supports policy and educational efforts to improve children's choices of away-from-home foods and beverages.

Consumption of caloric sweetened beverages when eating meals or snacks obtained at commercial food establishments or at school contributes to the adverse dietary effects of food away from home. About 35 percent of the caloric increase associated with food away from home is attributable to caloric sweetened beverages, as is 20 percent of the decline in HEI scores. Nevertheless, after controlling for the effects of consumption of caloric sweetened beverages, researchers find that, for all children, each away-from-home meal adds 65 calories and lowers diet quality scores by 4 percent, compared with meals prepared at home. For older children, the effect amounts to 107 additional calories for each away-from-home meal. These results suggest that food away from home and caloric sweetened beverages each contribute to the overall quantity and quality of the foods children consume.

The effects of food from school also differ between younger and older children. Again controlling for intake of caloric sweetened beverages, researchers find that consumption of all food from school does not appear to have negative effects on the diets of younger children (ages 6-13). However, among children ages 13-18, all food from school has effects similar to those of food away from home, increasing daily caloric intake by 145 calories and lowering diet quality scores by 3 percent, compared with food prepared at home. Older children and adolescents tend to consume more meals and snacks from all away-from-home sources than younger children. Thus, efforts to improve the quality of food away from home and food from school may especially benefit the older age group.

How was the study conducted?

Analysis is based on dietary recall data from the 2003-04 National Health and Nutrition Examination Survey and the 1994-96 Continuing Survey of Food Intakes by Individuals. Researchers used 2 days of dietary intake data from school-age children (ages 6-18) to obtain first-difference estimates of the effects of individual changes in the number of meals or snacks from foods prepared outside the home—from restaurants, fast food vendors and other commercial sources, or schools and day care centers—on diet quality. First-differencing, which controls for many personal characteristics and omits a great deal of selection bias, is also used to determine the effects of changes in consumption of caloric sweetened beverages on diet quality. Controlling for changes in beverage consumption provides a clearer picture of how food sources affect diet quality. Measures of diet quality include changes in total daily caloric intake, total daily HEI scores, and daily HEI component densities, such as fruit and vegetable cup equivalents per 1,000 calories of intake.

Introduction

In the last 30 years, the prevalence of obesity among children and adolescents in the United States has more than doubled for all age groups and tripled among those ages 12-19 (CDC, 2009). Childhood obesity is associated with increased risk of Type 2 diabetes, sleep apnea, high blood pressure and cholesterol, as well as negative social, emotional, and academic outcomes (Gable et al., 2008). In addition, estimates suggest overweight children face a 70-percent chance of becoming overweight or obese adults, putting them at increased risk of suffering numerous obesity-related health problems later in life (USDHHS, 2007).

The prevention of childhood obesity has therefore become a major public health objective (Healthy People 2010). In searching for the causes of rising childhood obesity, researchers have identified increased consumption of food prepared away from home as a potential culprit. Like adults, children today eat a larger share of their daily calories from foods prepared outside the home than they did 30 years ago. In 1977-78, the average child age 2-17 obtained 20 percent of his or her daily calories from food away from home (FAFH) (Guthrie et al., 2002). Analysis of 2003-06 data from the National Health and Nutrition Examination Survey (NHANES) finds that, on average, children today get roughly 35 percent of their calories from FAFH. Guthrie et al. (2002) find that FAFH is of lower nutritional quality than food prepared at home, having more fat and saturated fat and less dietary fiber, calcium, and iron. Unsurprisingly, many studies find that energy intake is higher and diet quality is lower among children who eat FAFH (particularly fast food) than among those who do not (see Bowman and Vinyard, 2004; French et al., 2001; Sebastian et al., 2009). Findings in other studies suggest that overweight or obese children may consume more FAFH (see Gills and Bar-Or, 2003).

The consumption of FAFH, however, may not be a direct cause of poor diet quality and weight gain. Instead, it may just be linked to these outcomes through other factors, such as family time constraints, access to various food outlets, and preferences for certain foods. In other words, it is likely that FAFH consumption, diet quality, and weight are all shaped by these other factors. An analysis of adult diets shows that not controlling for such unobservable factors could overestimate the effect of FAFH on energy intake by as much as 25 percent (Mancino et al., 2009). As such, the potential impact of targeting FAFH as a means to curb childhood obesity may be overstated as well.

The objective of this study is to investigate whether consumption of FAFH directly affects children's energy intake and diet quality. We use a fixed-effects estimator on 2 days of dietary recall data to isolate the effects of consumption of FAFH from unobserved fixed characteristics that are likely correlated with FAFH consumption. In contrast to previous work, we define FAFH as all food not prepared at home and separate food obtained from school (FFS) cafeterias from all other FAFH.

This is an important distinction, as children are likely to have a different range of food options in schools than in other food-away-from-home establishments. Moreover, policy levers for influencing food choices at schools differ from those available for influencing food choices at restaurants, fast food establishments, and other sources of food prepared away from home. Lunches and breakfasts served in schools as part of the USDA school meal

programs are subject to nutrition standards established by USDA. These standards could be modified in response to recent recommendations from the National Academy of Sciences' Institute of Medicine (IOM) (see IOM, 2009) or as part of Federal obesity prevention policies. Even foods and beverages sold outside the USDA school meal programs from snack bars and other sources (popularly referred to as "competitive foods" because they compete with USDA school meals) may be limited either by Federal, State, or local school policies. USDA now requires schools that participate in the USDA school meal programs to develop "wellness policies" that set standards for all foods and beverages sold in school. Many schools are trying to offer a more healthful mix of foods, sometimes by banning sales of competitive foods or limiting the types of these foods that can be sold. In addition, 31 States now have policies limiting access to or setting nutrition standards for competitive foods (Trust For America's Health, 2009).

In contrast, the policy options for altering food choices by children in restaurants, fast food establishments, and other commercial sources focus less on sales restrictions and more on informational efforts. Nutrition labeling on menus and other efforts to educate consumers may encourage parents—and some children—to change the way they typically select from among different types of foods and beverages. The shift in consumer demand that may result could also spur FAFH establishments to introduce more healthful menu options for children.

Given these differences in policy levers, it is important to disentangle the dietary effects of consuming school food from the effects of consuming other foods prepared away from home. Therefore, we separate them in our analysis and hereafter refer to food obtained at school as food from school (FFS) and food obtained from other sources as food away from home (FAFH).

We estimate the effects of an increase in the number of meals from FAFH and FFS on caloric intake and diet quality. Estimates are made for the entire sample of school-age children (ages 6-18)[1] and separately for younger children (ages 6-12) and adolescents (ages 13-18). We also test whether the effects of FAFH differ significantly from the effects of FFS and whether the effects of FAFH and FFS have changed between the two periods for which data are available: 1994-96 and 2003-04.

[1]While many children start school by age 5, this is not always the case. Our data left some ambiguities as to whether or not a child was currently attending school. As such, we use age 6 as our lower range.

Additionally, we investigate the extent to which the effects of FAFH and FFS on diet quality are driven by the consumption of caloric sweetened beverages (CSB). Children's consumption of CSBs, such as carbonated soft drinks, fruit drinks, and sport drinks, has risen in recent years (Wang et al., 2008) and now accounts for close to 10 percent of total caloric intake for this age group. As with the effects of consumption of FAFH and FFS, researchers hypothesize that increased consumption of CSBs is associated with the rise in obesity (see Malik et al., 2006; Vartanian et al., 2007). CSBs often accompany FAFH meals and are commonly available in vending machines in schools. Thus, it is possible that some of the effects attributed to FAFH and FFS could be driven by an association with consumption of CSBs. We therefore control for CSB consumption to investigate whether this association changes the magnitude of the estimated relationship between diet quality and food source. Findings provide additional insight into the effects of food sources on children's diets and weight status and can help inform strategies for the prevention of childhood obesity.

Previous Research on Food Away From Home

Research on the role of FAFH on children's weight status, energy intake, and diet quality has focused primarily on the correlations of these measures with either fast food consumption or availability, as measured by distance or price. A number of studies show that children who eat fast food or fried foods away from home more frequently than other children also consume more energy, caloric sweetened beverages, and fat while also consuming less milk and fewer fruits and vegetables (see Bowman et al., 2004; French et al., 2001; Paeratakul et al., 2003; Sebastian et al., 2009). Some evidence suggests that children who are overweight or obese eat FAFH more frequently and consume more total energy when doing so than healthy-weight children (see Gillis and Bar-Or, 2003; Ebbeling et al., 2004).

Among studies focused on correlations between body weight and access to restaurants and fast food establishments, some find that proximity to restaurants has little to no effect on children's weight (see Burdette and Whitaker, 2004; Sturm and Datar, 2005). Currie et al. (2009), however, find that having a fast food restaurant within one-tenth of a mile of a school correlates with increased weight gain and obesity among schoolchildren. Powell and Bao (2009) also find that the relationship between local fast food prices and elevated Body Mass Index (BMI) is more pronounced among low-income adolescents, who may have greater access to FAFH (Block et al., 2004) than the general population.

While demonstrating a strong correlation between either FAFH consumption or FAFH availability and specific outcomes, such as overweight/obesity and lower diet quality, these studies do not confirm that FAFH is a cause of these outcomes. As stated earlier, FAFH consumption is influenced by many of the same factors that affect both diet quality and body weight. Similarly, the use of FAFH access as a means to identify consumption poses two potential problems. First, the cited studies lack data on actual FAFH intake or purchases. Thus, there is no guarantee that any correlation between weight gain and FAFH access is due to increased FAFH consumption. Second, retailers choose to locate in areas with high demand. Because the demand for FAFH is driven by the same factors that influence diet quality and body weight, access is arguably an endogenous variable.

School Meals and Other Food Obtained at School

Given the important contribution of food obtained at school to the everyday diets of children, the effects of such foods on children's diets is of interest to researchers. Schools, like other nonhome food sources, now offer a more extensive and varied mix of eating options than in past decades. As of 2008, USDA school meal programs served 30.9 million lunches and 10.6 million breakfasts on an average schoolday. For participants, lunch contributes 31 percent of daily calories, whereas breakfast contributes 22 percent (Gordon et al., 2007). Nearly all children who eat school breakfast also eat school lunch; for such children, school meals may account for approximately half of their daily caloric intake.

USDA-sponsored meals are expected to meet Federal nutrition standards. And while most schools serve meals that meet standards for protein, vitamins, and minerals, many schools provide meals that exceed standards for fat and saturated fat and are also high in sodium[2] (Crepinsek et al., 2009). Other foods and beverages are also widely available in schools from vending machines, school stores and snack bars, or cafeterias, where they are sold as a la carte items. Overall, 40 percent of schoolchildren eat some type of competitive food or beverage on a given day (Fox et al., 2009). These competitive foods make up, on average, 13 percent of total daily calories for younger children and 15 percent for high schoolers. Competitive foods are not subject to the same Federal nutrition standards as foods that make up USDA meals. They tend to be low-nutrient, energy-dense foods, such as CSBs, high-fat baked goods, and desserts (Fox et al., 2009). As children age, their access to competitive foods expands and their consumption of USDA school lunches declines[3] (Fox et al., 2009). In addition, school lunch program meals appear to differ in quality by grade level, with meals served to secondary students being higher in fat than meals served to elementary students (Newman et al., 2009). The combination of less nutritious National School Lunch Program (NSLP) meals and more exposure to competitive foods may explain why previous research found that the positive qualities of foods consumed at school decline as students age (see Lin et al., 2001).

Despite these shortcomings, school meals are found to have several positive effects on students' diets, with program participants significantly more likely than nonparticipants to consume milk, fruit, and vegetables at lunchtime and less likely to eat desserts and snack items (Briefel et al., 2009). Intakes of CSBs at lunch by program participants are sufficiently lower than those of nonparticipants, resulting in a lower overall daily CSB intake (Briefel et al., 2009). However, as with the effects of FAFH, it is difficult to establish a causal relationship between school foods and diet quality because many of the same factors that influence school meal choice, such as food preferences and parental time constraints, also shape diet quality and body weight.

[2]Program regulations require that school lunches and breakfast provide one-third and one-quarter, respectively, of the 1989 Recommended Dietary Allowance of protein, calcium, iron, and vitamins A and C. USDA-sponsored school meals are expected to limit fat content to no more than 30 percent of the meal's calories and limit saturated fat to no more than 10 percent of calories. Schools are also encouraged to minimize sodium but are not held to a specific standard.

[3]In 2004-05, competitive foods were available in 73 percent of elementary schools, 97 percent of middle schools, and 100 percent of high schools (Fox et al., 2009). The likelihood of eating competitive foods also increases with age, with the share of students doing so rising from 29 percent in elementary school, to 44 percent in middle school, and to 55 percent in high school. At the same time, consumption of USDA school meals declines, with the share of students participating in the program dropping from 73 percent in elementary school, to 60 percent in middle school, and to 44 percent in high school.

Caloric Sweetened Beverages

Over the past three decades, children's beverage choices have registered a noticeable trend. Consumption of milk has declined, while consumption of carbonated soft drinks and fruit drinks has risen (table 1). Consumption of CSBs has also risen in recent years (Wang et al., 2009) and now makes up close to 10 percent of total caloric intake for this age group. Increased consumption of CSBs raises two concerns. First, it may displace consumption of more nutrient-rich beverages, such as low-fat milk. Second, rather than serving as a substitute for other foods and beverages, it may add calories to the diet, increasing the risk of obesity. Physiological research finds that self-compensation for calories consumed as certain liquids, such as CSBs, is imprecise and thus increases the likelihood of an individual's consuming excess calories (Mattes, 1996). Ludwig et al. (2001) find that in a sample of school-age children, over a 19-month period, CSB consumption is associated with increased risk of becoming overweight. Two recent reviews of the literature conclude that CSB consumption is linked with increased risk of obesity and diabetes (see Malik et al., 2006; Vartanian et al., 2007). It is noted that CSBs often accompany FAFH meals and, during the time data were collected for this study, they were commonly available in vending machines in schools (CDC, 2006; Briefel et al., 2009). Clearly, obesity, FAFH, FFS, and CSB consumption are linked, making it very challenging to sort out the specific effects that each may have on obesity.

Table 1
Daily per capita consumption of beverages among children ages 2-18

Beverage	1977-78	1994-96	2003-06
		Ounces	
Nondiet soft drinks	4.61	8.94	9.39
Fruit drinks	3.03	5.07	5.66
Milk	14.77	11.30	9.60

Source: USDA, Economic Research Service analysis of Continuing Survey of Food Intakes of Individuals and National Health and Nutrition Examination Survey first-day dietary recall data.

Data and Sample

We use data from two nationally representative surveys covering the periods 1994-96 and 2003-04. The Continuing Survey of Food Intakes by Individuals (CSFII) collected 2 nonconsecutive days of dietary recall data between 1994 and 1996 for a sample of adults and children. Both days of intake data were collected through interviews with survey participants. The National Health and Nutrition Examination Survey, conducted by the Centers for Disease Control and Prevention, expanded intake data collection from 1 day to 2 days in 2002 but only began releasing both days of dietary intake in 2003. Because USDA managed the dietary intake component for both surveys, many of the questions, such as those asking where foods were eaten and obtained, are the same in both surveys. This facilitates combining the two surveys together and allows us to link responses to the appropriate MyPyramid Equivalents databases (MPED) (Friday and Bowman, 2006; Bowman et al., 2008) and, consequently, calculate the 2005 Healthy Eating Index (HEI-2005) scores. The 2003-04 NHANES is the most recent dataset containing 2 days of dietary intake for which the HEI-2005 can be constructed.[4] As will be described in more detail, the index is based on per calorie intake and thus supports comparison of intakes that vary in quantity. We limit our sample to school-age children between ages 6 and 18.

[4]The 2005-06 NHANES intake data have been released, but the corresponding MyPyramid Equivalents Database has not.

We examine the effects of FAFH, FFS, and CSB consumption on aggregate and specific measures of diet quality. The aggregate measures are total daily caloric (energy) intake and total HEI-2005 score. Excessive energy intake is a main factor in weight gain. The HEI-2005, developed by USDA's Center for Nutrition Policy and Promotion (CNPP), is an index that measures how well an individual's diet adheres to the 2005 *Dietary Guidelines for Americans* (see USDHHS/USDA 2005; Guenther et al., 2008). The total score is the sum of an individual's scores on 12 components: total fruit; whole fruit; total vegetables; dark-green and orange vegetables and legumes; total grains; whole grains; milk; meat and beans; oils; saturated fat; sodium; and extra calories from solid fat and added sugar (extra calories). The *Dietary Guidelines* recommend consuming at least a minimum amount for the first nine components and consuming no more than a maximum amount for the last three components, while also balancing daily caloric intake with daily caloric expenditure.

These component scores are created using a density approach. For fruit, vegetables, grains, milk, meat, and beans, densities reflect the number of cups or ounce equivalents per 1,000 calories consumed by an individual daily. For oils and sodium, the densities measure the grams and milligrams consumed per 1,000 calories, respectively. For saturated fat and extra calories, densities measure the share of an individual's daily caloric consumption. This analysis focuses specifically on measures of the component densities for which current dietary intake is lacking—total fruit, whole fruit, total vegetables, dark-green and orange vegetables, whole grains, and milk—and is excessive—saturated fat, sodium, and extra calories (Guenther et al., 2008; Fungwe et al., 2009). Table 2 summarizes the intake corresponding to a maximum score for each of these components in the HEI-2005.

Table 2

Intake densities corresponding to maximum component score in HEI-2005 measure

HEI-2005 component	Intake for maximum score
Total fruit	≥ 0.8 cup equivalents
Whole fruit	≥ 0.4 cup equivalents
Whole grains	≥ 1.5 oz. equivalents
Milk	≥ 1.3 cup equivalents
Total vegetable	≥ 1.1 cup equivalents
Dark-green, orange vegetables	≥ 0.4 cup equivalents
Saturated fat*	≤ 7 percent
Sodium	≤ 700 milligrams
Extra calories*	≤ 20 percent

Note: *Intake is percent of total energy; otherwise, densities are per 1,000 kcal. HEI = Healthy Eating Index.

Source: USDA, Economic Research Service using data from Guenther et al. (2007).

Following the approach used in Todd et al. (2010), in this study, eating occasions are classified as FAFH based on the source from which respondents report each food was obtained. Regardless of where the foods were consumed, foods obtained from fast food or table service restaurants are classified as FAFH.[5] Foods obtained from a school cafeteria or day care center are identified as FFS.[6] The FFS classification includes any food sold at school—those sold as part of the USDA school meals as well as competitive foods sold a la carte. Meals that contain foods from multiple sources are classified based on the source of the food (excluding beverages) that accounts for the majority of the meal's calories. For example, if a student reports eating a lunch or breakfast from school and a dessert from home, the eating occasion is identified as a food from school meal as long as the food from school provides more than 50 percent of the calories consumed during that meal. The final category, food at home (FAH), comprises the remaining food sources. The majority (97 percent) of foods classified as FAH come from some sort of grocery store or from someone else, such as a dinner prepared by a friend. Meals are classified as breakfast, lunch, dinner, or snack based on the respondent's stated definition of the eating occasion.

[5]For example, a lunch obtained off campus during school hours is classified as FAFH, even if the student brought that meal back to school.

[6]For completeness, we include foods obtained at day care centers with foods obtained at schools. It is possible that some of the day care providers were located in schools, so foods available would be similar in both. These foods make up a small portion of this category—less than 4 percent of eating occasions classified as food from school contain food from day care.

Beverages are classified using the USDA eight-digit food-code descriptors in the CSFII and NHANES. Regardless of where a respondent obtained a beverage, if the product contained some sort of caloric sweetener, such as sugar or corn syrup, it is classified as a caloric sweetened beverage. Specifically, the caloric sweetened beverages defined as CSBs come from one of the following categories—fruit or fruit-flavored drinks, energy drinks, flavored water, coffees, teas, and nonalcoholic, or "virgin," beverages, such as nonalcoholic wines and beers.

Based on an approach that uses Stata 10.1 to account for sampling weights and incorporate survey design, sample means are reported in table 3 for the explanatory and dependent variables for the full sample of children. The table includes both the 2-day mean as well as the 2-day difference for each variable for the pooled sample (both the 1994-96 and 2003-04 surveys). Average daily caloric intake for children is nearly 2,124 calories, with an average difference

Table 3
Summary statistics, children ages 6-18, 1994-96 and 2003-04 pooled

	Two-day means		Two-day differences (day 2 - day 1)	
	2-day means		2-day differences	
Dependent variables	Mean	SE of mean	Mean	SE of mean
Daily energy intake (kcal)	2,124.12	18.36	-113.60	17.19
HEI-2005	48.66	0.34	0.57	0.59
Total fruit density (cup equiv. per 1,000 kcal)	0.49	0.01	0.01	0.02
Whole fruit density (cup equiv. per 1,000 kcal)	0.24	0.01	0.02	0.01
Whole grain density (ounce equiv. per 1,000 kcal)	0.28	0.01	0.00	0.01
Dairy density (cup equiv. per 1,000 kcal)	1.03	0.02	0.02	0.02
Vegetable density (cup equiv. per 1,000 kcal)	0.56	0.01	0.02	0.02
Dark-green, orange density (cup equiv. per 1,000 kcal)	0.04	0.00	0.01	0.00
Percent saturated fat (percent of energy)	11.62	0.06	-0.04	0.10
Sodium density (milligrams per 1,000 kcal)	1,570.98	8.66	26.41	13.00
Percent of energy from extra calories	38.43	0.26	-0.95	0.37
Explanatory variables				
Breakfast—1 respondent ate breakfast; 0 otherwise	0.81	0.01	0.03	0.01
Lunch—1 respondent ate lunch; 0 otherwise	0.83	0.01	0.04	0.01
Dinner—1 respondent ate dinner; 0 otherwise	0.93	0.00	0.00	0.01
Snack (number)	1.39	0.02	-0.22	0.02
Number of meals away from home	0.50	0.01	-0.07	0.02
Number of meals from foods sold at school	0.32	0.02	-0.02	0.02
Caloric sweetened beverages consumed (grams)	559.51	12.59	-66.05	12.53
Weekend—1 recall occurred on a weekend; 0 otherwise	0.30	0.01	0.01	0.00
Demographic subgroups				
Male	0.52	0.01	n/a	n/a
NHANES (observed in 2003-04)	0.52	0.02	n/a	n/a

Note: The pooled sample size is 5,285: 1994-96 is 2,690 and 2003-04 is 2,595. Weighted means reported; Stata 10.1 is used to incorporate the complex survey design adjust the standard errors. Sample includes only children who reported 2 days of dietary intake data.
NHANES = National Health and Nutrition Examination Survey. n/a = not applicable.

Source: USDA, Economic Research Service.

between the 2 days of nearly 114 calories. The mean HEI-2005 score is less than 50 (out of a maximum of 100), and the average daily variation is less than 1 (0.34). Average intake of milk per 1,000 calories comes closest to the recommended amount (1.03 cup equivalents versus 1.3 cup equivalents for a maximum component score). For other components in which average intake is below the level corresponding to the maximum HEI-2005 score, the deficits range from 40 percent (whole fruit) to 90 percent (dark-green and orange vegetables). For components in which intake is above the recommended levels, consumption exceeds recommendations by 66 percent for saturated fat, 92 percent for extra calories, and 114 percent for sodium.

Because past research shows that the healthfulness of the school food environment declines as students progress through the school system (see

Finkelstein et al., 2008; Briefel et al., 2009), we separate children into two age groups: those in elementary school (ages 6-12) and those in middle and high school (ages 13-18). Table 4 presents sample means for each subgroup of children. As expected, older children consume more calories per day but consume less fruit, whole grains, and milk. Younger children are less likely to skip meals and more likely to consume snacks and eat more meals from food from school. In contrast, older children consume more meals from food away from home. Older children also consume more caloric sweetened beverages (68 percent more than younger children).

Table 4
Summary statistics by age group, 1994-96 and 2003-04 pooled data

	Children ages 6 to 12 (n=2,677)			Children ages 13 to 18 (n=2,608)	
Dependent variables	**Mean**	**SE**		**Mean**	**SE**
Daily energy intake (kcal)	1,996.67	23.74		2,269.10	32.27
HEI-2005	49.75	0.46		47.43	0.35
Total fruit density (cup equiv. per 1,000 kcal)	0.54	0.02		0.43	0.02
Whole fruit density (cup equiv. per 1,000 kcal)	0.29	0.01		0.19	0.01
Whole grain density (ounce equiv. per 1,000 kcal)	0.32	0.01		0.23	0.01
Dairy density (cup equiv. per 1,000 kcal)	1.13	0.02		0.91	0.03
Vegetable density (cup equiv. per 1,000 kcal)	0.53	0.01		0.60	0.01
Dark-green, orange density (cup equiv. per 1,000 kcal)	0.04	0.00		0.04	0.00
Percent saturated fat (percent of energy)	11.74	0.08		11.47	0.09
Sodium density (milligrams per 1,000 kcal)	1,556.48	11.22		1,587.48	11.73
Percent of energy from extra calories	37.90	0.28		39.03	0.35
Explanatory variables					
Breakfast	0.88	0.01		0.73	0.01
Lunch	0.88	0.01		0.77	0.01
Dinner	0.95	0.00		0.91	0.01
Snack	1.43	0.03		1.34	0.03
Number of meals away from home	0.40	0.01		0.61	0.02
Number of meals at school	0.38	0.02		0.25	0.02
Caloric sweetened beverages consumed (grams)	420.86	12.18		717.24	19.08
Dietary recall occurred on the weekend	0.30	.008	0.01	0.00	0.30
Demographic subgroups					
Male	0.52	0.01		0.51	0.01
NHANES (observed in 2003-04)	0.51	0.02		0.53	0.02

Note: Weighted means reported; Stata 10.1 is used to incorporate the complex survey design adjust the standard errors. Samples include only children who reported 2 days of dietary intake data. NHANES = National Health and Nutrition Examination Survey. HEI = Healthy Eating Index.

Source: USDA, Economic Research Service.

Estimation Approach

Estimates using the pooled data

One common approach to estimating the effect of FAFH and FFS on diet quality is to treat them as an exogenous, explanatory variable and estimate a regression of the following form:

$$DQ_i = \alpha + \beta X_i + \gamma FAFH_i + \theta FFS_i + \mu_i + \varepsilon_i \qquad (1)$$

where DQ is a measure of diet quality for individual i; X is a vector of control variables, such as age and gender; FAFH is the number of meals from FAFH; FFS is the number of meals from school; $\mathbf{\mu}_i$ is a vector of relevant unobservable factors, such as food preferences, parental time constraints, and access to various food outlets; and ε_i is a stochastic error term.

However, as has been argued, FAFH and FFS consumption are driven by many of the same unobservable variables in $\mathbf{\mu}$. Not controlling for this relationship between $\mathbf{\mu}$ and either FAFH or FFS will bias estimates of γ and θ. To obtain unbiased estimates, one must separate the choice of FAFH and FFS from the relevant unobservable factors in $\mathbf{\mu}$. Leveraging the fact that the number of meals eaten away from home or obtained from school may vary across the 2 days of intake, one can isolate the effects of FAFH and FFS from the factors in $\mathbf{\mu}$ that are fixed over time by estimating a regression on the differences between days:

$$DQ_{i2} - DQ_{i1} = (\alpha - \alpha) + \beta(\mathbf{X}_i - \mathbf{X}_i) + \gamma(FAFH_{i2} + FAFH_{i1}) + \theta(FFS_{i2} - FFS_1) + (\mathbf{\mu}_i - \mathbf{\mu}_i) + (\varepsilon_{i2} - \varepsilon_{i1})$$

Or more simply:

$$\Delta DQ_i = \gamma(\Delta FAFH_i) + \theta(\Delta FFS_i) + \Delta\varepsilon_i \qquad (2)$$

Equation (2) is a first-difference model, which is equivalent to a fixed-effects model when there are only two observations per person. Because the 2 days of dietary intake in the data are collected 7-10 days apart, it is reasonable to assume that the majority of these relevant, unobservable factors are fixed during the survey period.[7] Thus, even though data are not available on all relevant, unobservable factors, such as food preferences, parental time constraints, and access to food outlets, this approach controls for factors that remain fixed over the survey period because they simply fall out of equation 2 when estimating first differences.

While the first-difference model removes the bias from the estimates of γ and θ from time-invariant unobserved factors, there may still be some bias from unobserved time-varying factors. To help control for time-varying unobserved factors, such as daily variations in parental time constraints, we also estimate for the effects of changing meal patterns, such as whether an individual skipped breakfast on one of the days, whether the number of snacks consumed changed, and whether the recall day was on a weekday or weekend.

[7]The fixed-effects estimator has been used extensively to remove bias from unobservable factors (see, for example, Mancino et al. (2009), who estimate the effect of FAFH on calories and HEI scores among adults; Hersch and Stratton (1997), who estimate the effect of housework time on wages; and Behrman and Deolalikar (1990), who estimate the effect of income on nutrient demand).

$$\Delta DQ_i = \gamma(\Delta FAFH_i) + \theta(\Delta FFS_i) + \sum_{j=1}^{4} \phi_j(\Delta MEAL_{ij}) + \delta(weekend_i) + \Delta\varepsilon_i \quad (3)$$

Equation (3) is used to estimate the effects on diet quality of obtaining one additional meal from FAFH (γ) and one additional meal from FFS (θ). The effects of eating occasions (ϕ_j) are indexed by j (for example, breakfast, lunch, dinner, or snack).[8] Equation (3) estimates total energy consumed in a day and the total HEI-2005 score for all children, and then separately for elementary school children (ages 6-12) and older children (ages 13-18).

[8] The breakfast, lunch, and dinner variables are all dichotomous. They indicate whether an individual ate a specific meal or had at least one snack on that intake day. Thus, the differenced values used in our estimates take on values of -1. As an example, a value of -1 for breakfast would indicate an individual skipped breakfast on the first day of the recall and ate a breakfast on the second, a value of 1 would indicate he or she ate breakfast on the first day and skipped it on the second, and a value of zero would indicate no change between the 2 days The snack variable measures the change in the number of snacks eaten on the particular day.

As discussed previously, it is possible that some of the negative effects of FAFH could be attributable to an increase in consumption of CSBs, which offer little in the form of nutrition other than calories. To help separate the effect of CSBs from FAFH and FFS, we add the change in consumption of CSBs (measured in units of 100 grams, or approximately 3.5 ounces):

$$\Delta DQ_i = \gamma(\Delta FAFH_i) + \theta(\Delta FFS_i) + \sum_{j=1}^{4} \phi_j(\Delta MEAL_{ij}) + \lambda(\Delta CSB_1)$$
$$+ \delta(\Delta weekend_i) + \Delta\varepsilon_i \quad (4)$$

In equation (4), γ again estimates the effect of a meal from FAFH, and θ estimates the effect of a meal from FFS; however, these effects now hold the consumption of CSBs constant. Thus, the effect for FAFH and FFS in equation (4) is net of the change in consumption of CSBs. A comparison of the estimates from (4) with those from (3) reveals the degree to which consumption of CSBs accounts for the total effects of FAFH and FFS. Dependent variables include total daily calories, total HEI score, and specific HEI components—total fruit, whole fruit, whole grain, milk, all vegetables, dark-green/orange vegetables, share of calories from saturated fat, and extra calories.

Estimates by survey to test for differences over time

After equation (4) is estimated with the pooled data for all children and for both age groups, it is estimated separately for the 1994-96 and 2003-04 samples to test whether the effect of eating out on various measures of diet quality changed over time. Both restaurant and school food environments underwent changes in recent years, possibly modifying the effect that consumption of food obtained from these sources has on individual diet quality. In the case of restaurants, many establishments voluntarily began to provide nutritional information for menu items, as well as to modify their menu offerings to include more healthful options. Greater media exposure of the potential negative effects of FAFH may have swayed some consumers to alter their food choices when dining out.

In the case of schools, a number of legislative acts and policy changes since 1994 may have spurred changes in the quality of FFS. The 1994 Healthy Meals for Healthy Americans Act effected changes in nutrition standards for school meals by placing a priority on limiting fat and saturated fat (see Ralston et al., 2008, for policies affecting the National School Lunch Program). While the average fat content of school meals has declined since the 1990s (Gordon et al., 2007), USDA breakfasts and lunches in

many schools still do not meet nutrition standards for fat and saturated fat (Crepinsek et al., 2009). Schools are encouraged, but not required, to serve more dark-green and orange vegetables, more whole grains, and less sodium. In 2004-05, few schools served the recommended amounts of these food groups. Also, virtually no schools served meals that met the sodium limits suggested by the 2005 *Dietary Guidelines for Americans*. Not surprisingly, the American food supply and the average American diet are also excessively high in sodium (Carlson et al., 2007; Guenther et al., 2008).

In addition to changes in USDA school meals, changes in the availability of competitive foods may affect the relationship between FFS and diet quality. In recent years, more States and school districts have taken actions to limit or ban the availability of low-nutrient, energy-dense competitive foods in schools (Trust for America's Health, 2009). Despite these efforts, findings in the School Nutrition Dietary Assessment Study (SNDA) III reveal that in 2004-05, such foods were still widely available in American schools, particularly in middle and high schools (Fox et al., 2009).

Effects of FAFH, FFS, and CSB on Diet Quality

Without controlling for the effect of caloric sweetened beverages, each meal away from home adds 106 calories to total daily energy intake; meals from school add half as much.

Our findings suggest that, even after controlling for the unobserved characteristics affecting both FAFH consumption and diet quality, FAFH has an adverse impact on various measures of children's diet quality. Because the analysis controls for each meal consumed, the coefficients on FAFH and FFS estimate the difference between a meal obtained from either source (FAFH or FFS) and a meal obtained from home. Based on estimates obtained using equation (3) (first column of results for each sample), for all children, each meal away from home is estimated to add 106 calories to the total daily calories that would have been obtained if all meals were obtained from home (table 5). FFS is estimated to add 55 calories to total daily intake. The estimated effects vary between the two age groups. Among children ages 6-12, each FAFH meal adds 65 calories to the total daily intake, while each FFS meal has no significant effect. Among

Table 5

Effects of meals consumed from FAFH and FFS on daily energy intake and HEI-2005 scores of children ages 6-18

Energy	All children ages 6-18		Ages 6-12		Ages 13-18	
FAFH meal	106.417***	64.915***	64.738**	17.234	144.388***	107.499***
	(20.974)	(18.693)	(25.416)	(21.180)	(31.412)	(30.687)
FFS meal	54.711*	76.615**	10.637	44.804	146.435***	144.819***
	(30.009)	(29.627)	(40.484)	(42.765)	(48.356)	(46.607)
100 grams of CSB		37.026***		39.216***		34.742***
		(2.728)		(5.568)		(4.140)
Observations	5285	5285	2677	2677	2608	2608
R-squared	0.11	0.16	0.09	0.14	0.13	0.18
Gap between FFS and FAFH	51.705	-11.699	54.102	-27.570	-2.046	-37.321
HEI						
FAFH meal	-2.608***	-2.019***	-2.810***	-1.917***	-2.479***	-2.039***
	(0.362)	(0.355)	(0.429)	(0.431)	(0.432)	(0.417)
FFS meal	-0.205	-0.515	0.403	-0.239	-1.601***	-1.581**
	(0.465)	(0.498)	(0.784)	(0.780)	(0.585)	(0.600)
100 grams of CSB		-0.525***		-0.737***		-0.415***
		(0.044)		(0.081)		(0.041)
Observations	5285	5285	2677	2677	2608	2608
R-squared	0.05	0.09	0.05	0.10	0.05	0.09
Gap between FFS and FAFH	-2.403***	-1.504**	-3.213***	-1.677*	-0.878	-0.457

FAFH = food away from home: FFS = food from school (includes all foods obtained at school). CSB = caloric sweetened beverages. Standard errors in parentheses; *** significant at 1 percent, ** significant at 5 percent, * significant at 10 percent; additional controls include whether the respondent ate breakfast, lunch, dinner, or a snack each day and whether the recall day was on a weekend; survey weights and complex design incorporated using svy command in STATA 10.1. HEI = Healthy Eating Index.

Source: USDA, Economic Research Service.

older children, FAFH and FFS have similar effects on total calories—each adds about 145 more calories to total daily intake than does a lunch from home. However, when testing for differences between the effect of FAFH and the effect of FFS on total daily calories, we find no significant difference between the two food sources for either age group.

In terms of diet quality, we find that FAFH has a significant and negative effect on HEI-2005 scores as well. Each FAFH meal is estimated to decrease HEI scores by 2.6 points for all children (about 5 percent of the average HEI score of 48.66), 2.8 points for children ages 6-12, and 2.5 points for children ages 13-18. The effect of FFS on HEI varies by children's age. While each FFS meal is found to have no significant net effect on HEI for younger children, each meal from school is estimated to significantly decrease diet quality by 1.6 points for children ages 13-18. This likely reflects the trend toward less healthful food environments in middle and high schools than in elementary schools. However, it is important to note that even if the negative effects of FAFH or FFS on diet quality were removed, the expected HEI score would still only reach 50 out of a possible 100 points. This highlights the fact that issues of poor diet quality relative to dietary recommendations are pervasive in our food choices and unlikely to improve solely by adjusting FAFH and FFS policies.

Controlling for intake of caloric sweetened beverages lowers FAFH's estimated effect on calories.

After controlling for the change in the amount of caloric sweetened beverages consumed (equation 4), the analysis finds that at least some of the negative effect of FAFH is tied to the consumption of these beverages (table 5, second column of results for each sample). For all children, when the change in the amount of CSBs consumed is added to the regression, the estimate of the effect of FAFH meals drops from 106 to 65 calories added per day but the difference between FAFH and FFS remains insignificant. Each 100 grams of CSBs is estimated to increase daily caloric intake by 37 calories. (For context, a 12-ounce can of soda or other CSB weighs roughly 355 grams,[9] with the number of calories per 100 grams varying across beverage type: 100 grams of nondiet cola contain approximately 40 calories, 100 grams of fruit punch contain 50 calories, and 100 grams of a sports drink contain 20 calories.) Estimates suggest that each calorie consumed from CSBs increases daily caloric intake, in general, on a one-to-one basis. The average child in this sample consumes about 560 grams of CSBs per day (see table 3), which equates to roughly 185 extra calories per day.

When the sample is split into two age categories, the standard errors increase and the estimates become less precise. As such, the coefficients on FAFH and FFS after controlling for CSB consumption may overlap with those generated without controlling for CSB intake. However, the general pattern is the same as that observed in the full sample. For children ages 6-12, neither FAFH nor FFS has a significant effect on daily caloric intake after accounting for consumption of CSBs, and CSBs are estimated to add 39 calories to intake (per 100 grams). For older children (ages 13-18), the effect on intake of all FAFH is reduced (107 calories per meal) after accounting for CSB consumption (100 grams of CSB increase intake by 35 calories), and the net effect of food from school remains at 145 calories.

[9]One fluid ounce is equal to 29.57 grams. Conversely, 1 gram is equal to .03381 ounces.

Even after controlling for CSB consumption, FAFH adversely affects HEI-2005 total scores.

Controlling for CSB consumption reduces the effect of FAFH and FFS on calories but not the effect of FAFH on total HEI scores. After controlling for CSBs, each FAFH meal reduces the total HEI-2005 score by just over 2 points for all children (see table 5), which is roughly 4 percent of the mean score. Point estimates are similar for both age groups. FFS has no significant effect on the HEI score for all children and for children ages 6-12. However, each FFS meal reduces the total HEI-2005 score for older children (ages 13-18) by 1.6 points. Again, this may be due to greater access to competitive and a la carte foods for students in middle and high schools.

On average, every 100 grams of CSBs reduces HEI scores for all children by 0.5 points (1.1 percent); the equivalent of a 12-ounce soda is estimated to reduce scores by 1.8 points, or 3.5 percent from the mean score. The effects of CSBs also differ by age group, with a larger negative effect among younger children (0.74 points per 100 grams; 2.5 points per 12 ounces) than among older children (0.4 points per 100 grams; 1.4 points per 12 ounces). Because CSB consumption is found to have a significant effect on calorie intake and diet quality for both age groups, the analysis controls for CSB consumption in all remaining regressions.

FAFH lowers children's diet quality by reducing intake of food groups for which consumption is encouraged, while increasing intake of those that should be consumed in moderation.

Analysis of the HEI component density scores shows that FAFH negatively affects children's diet quality by reducing dietary density, or share of total calories, of the food groups that are encouraged—fruit, whole fruit, whole grains, all vegetables, and dark-green vegetables (table 6). At the same time, FAFH increases the share of calories from components that are already consumed in excess—saturated fat, sodium, and extra calories (added sugar and solid fat). The adverse effect of FAFH on HEI component scores, except for those on fruits and whole grains, is more pronounced among older children.

Among all children, each meal from FFS increases the density of milk in the diet. Among younger children, FFS also reduces the density of sodium in the diet. Among older children, who typically face a less healthful food environment in schools, each FFS meal has a significant and adverse effect on several components of diet quality: it lowers the dietary density of total fruit, whole grains, and dark-green vegetables and increases the density of saturated fat and extra calories (those from added sugar and solid fat). Though the effect is less pronounced, FFS is also estimated to increase the share of calories from saturated fat among younger children.

For both groups of children, consumption of CSBs reduces the density of all healthful meal components (except all vegetables) and increases intake of extra calories. As stated earlier, CSB consumption as measured in calories has a nearly one-to-one relationship with increases in daily caloric intake. These findings suggest that CSBs decrease HEI component measures by adding calories that contain little else besides added sugar. Thus, the negative

Table 6

Effects of meals consumed from FAFH and FFS on HEI component densities of children ages 6-18

	Total fruit			Whole fruit			Whole grains		
	All children ages 6-18	Ages 6-12	Ages 13-18	All children ages 6-18	Ages 6-12	Ages 13-18	All children ages 6-18	Ages 6-12	Ages 13-18
FAFH meal	-0.051***	-0.063***	-0.041**	-0.045***	-0.045**	-0.040***	-0.041***	-0.059***	-0.027*
	(0.012)	(0.021)	(0.019)	(0.011)	(0.022)	(0.013)	(0.011)	(0.019)	(0.014)
FFS meal	-0.022	0.004	-0.079**	-0.015	-0.035	-0.000	-0.069**	-0.060	-0.066**
	(0.027)	(0.036)	(0.034)	(0.021)	(0.029)	(0.017)	(0.030)	(0.039)	(0.026)
100 grams of caloric sweetened beverage	-0.021***	-0.025***	-0.018***	-0.009***	-0.015***	-0.006***	-0.002*	-0.002	-0.003
	(0.002)	(0.004)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.003)	(0.002)
R-squared	0.04	0.05	0.03	0.02	0.03	0.01	0.01	0.02	0.02
Gap between FFS and FAFH	-0.029	-0.067*	0.038	-0.030	-0.010	-0.040	0.028	0.001	0.039

	Dairy			All vegetables			Dark-green vegetables		
	All children ages 6-18	Ages 6-12	Ages 13-18	All children ages 6-18	Ages 6-12	Ages 13-18	All children ages 6-18	Ages 6-12	Ages 13-18
FAFH meal	0.004	-0.010	0.010	-0.065***	-0.040*	-0.082***	-0.026***	-0.018***	-0.032***
	(0.022)	(0.028)	(0.024)	(0.018)	(0.023)	(0.025)	(0.003)	(0.005)	(0.004)
FFS meal	0.203***	0.221***	0.173***	0.023	-0.000	0.049	-0.011*	-0.006	-0.023***
	(0.027)	(0.036)	(0.040)	(0.023)	(0.021)	(0.042)	(0.006)	(0.006)	(0.008)
100 grams of CSB	-0.025***	-0.024***	-0.027***	-0.004*	-0.009***	-0.001	-0.001*	-0.001	-0.001
	(0.002)	(0.005)	(0.003)	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
R-squared	0.10	0.11	0.09	0.02	0.02	0.03	0.02	0.01	0.03
Gap between FFS and FAFH	-0.200***	-0.232***	-0.163***	-0.088***	-0.039	-0.130***	-0.0146**	-0.012	-0.009

	Percent saturated fat			Sodium			Extra calories		
	All children ages 6-18	Ages 6-12	Ages 13-18	All children ages 6-18	Ages 6-12	Ages 13-18	All children ages 6-18	Ages 6-12	Ages 13-18
FAFH meal	0.466***	0.456***	0.491***	-47.773***	-39.557**	-50.304**	1.637***	1.407***	1.752***
	(0.103)	(0.147)	(0.151)	(15.712)	(17.175)	(23.588)	(0.270)	(0.305)	(0.371)
FFS meal	0.514***	0.417**	0.737***	-28.508*	-56.963***	21.270	0.835**	0.800	1.293***
	(0.140)	(0.188)	(0.214)	(16.547)	(19.875)	(32.445)	(0.340)	(0.512)	(0.430)
100 grams of CSB	-0.113***	-0.098***	-0.124***	-13.027***	-13.363***	-13.133***	0.803***	0.938***	0.731***
	(0.013)	(0.018)	(0.017)	(1.653)	(2.569)	(2.097)	(0.045)	(0.091)	(0.042)
R-squared	0.04	0.03	0.06	0.04	0.03	0.05	0.21	0.20	0.22
Gap between FFS and FAFH	-0.048	0.040	-0.246	-19.265	17.405	-71.574*	0.802*	0.607	0.459

FAFH = food away from home: FFS = food from school (includes all foods obtained at school): N=5,825. CSB = caloric sweetened beverages. Standard errors in parentheses; *** significant at 1 percent, ** significant at 5 percent, * significant at 10 percent; additional controls include whether the respondent ate breakfast, lunch, dinner, or a snack each day and whether the recall day was on a weekend; survey weights and complex design incorporated using svy command in Stata 10.1. HEI = Healthy Eating Index.

Source: USDA, Economic Research Service.

effects of FAFH on the diet quality of children may be mitigated by replacing the standard beverage in restaurant meals, usually some sort of soft drink, with a more healthful alternative, such as water or low-fat milk.

Among both younger and older children, there have been no significant changes in the effects of FAFH or FFS on calorie intake or diet quality over time.

Across time periods (1994-96 and 2003-04), there are few statistically significant changes in the effects of FAFH, FFS, and CSB intake for younger children (tables 7 and 8). While in many cases, the point estimates differ across the two periods, small sample sizes and subsequent large standard errors lead to statistically insignificant differences. The only notable changes between the two time periods are in the effect of CSB consumption on diet quality—between 1994-96 and 2003-04, the adverse effect of CSBs on milk intake declined and the effect on extra calories was mixed. For younger children, the effect of CSBs grew between 1994-96 and 2003-04. For older children, the effect decreased. While statistically significant, the estimated effects were quite small.[10]

[10] As an example, among children ages 13-18, the estimated impact of each 12-ounce can of soda was to reduce one's daily milk density by .10 cups per 1,000 calories in 1994-96. In 2003-04, the estimated impact of a can of soda was to reduce daily milk density by .07 cups. For a 2,000 calorie-a-day diet, the difference between the two time periods is roughly equivalent to 1 tablespoon of milk.

Table 7

Effects of FAFH and FFS on total calories, HEI-2005, and component densities of children ages 6 to 12

	Energy			Total HEI score			Total fruit			Whole fruit		
	1994-96	2003-04		1994-96	2003-04		1994-96	2003-04		1994-96	2003-04	
FAFH meal	3.106	38.909		-1.868***	-1.763**		-0.076***	-0.041		-0.050**	-0.031	
	(31.881)	(22.563)		(0.547)	(0.679)		(0.025)	(0.036)		(0.025)	(0.037)	
FFS meal	41.238	49.427		0.152	-0.623		0.015	-0.009		0.012	-0.077	
	(33.491)	(75.096)		(0.654)	(1.466)		(0.041)	(0.059)		(0.030)	(0.046)	
100 grams of CSB	38.369***	42.441***		-0.775***	-0.683***		-0.037***	-0.019***	++	-0.020***	-0.012***	+
	(5.347)	(7.583)		(0.077)	(0.120)		(0.005)	(0.005)		(0.004)	(0.003)	
R-squared	0.19	0.13		0.11	0.11		0.07	0.04		0.05	0.04	
Gap between FFS and FAFH	-38.132	-10.51777		-2.020**	-1.1396		-0.091**	-0.0322		-0.062**	0.0462	

	Whole grains			Dairy			All vegetables			Dark-green vegetables		
	1994-96	2003-04		1994-96	2003-04		1994-96	2003-04		1994-96	2003-04	
FAFH meal	-0.021	-0.088**	+	0.005	-0.028		-0.024	-0.057		-0.015**	-0.021**	
	(0.021)	(0.033)		(0.030)	(0.055)		(0.020)	(0.041)		(0.007)	(0.009)	
FFS meal	-0.023	-0.093		0.216***	0.222***		-0.012	0.018		-0.015	0.003	
	(0.025)	(0.077)		(0.033)	(0.066)		(0.023)	(0.034)		(0.010)	(0.007)	
100 grams of CSB	-0.009**	0.006	++	-0.042***	-0.012**	+++	-0.005	-0.010**		-0.001	-0.000	
	(0.004)	(0.005)		(0.006)	(0.005)		(0.004)	(0.005)		(0.001)	(0.001)	
R-squared	0.01	0.04		0.14	0.10		0.01	0.04		0.01	0.02	
Gap between FFS and FAFH	0.002	0.005	+	-0.163***	-0.088***		-0.012	-0.075		0.000	-0.025	

	Percent saturated fat		Sodium		Extra calories		
	1994-96	2003-04	1994-96	2003-04	1994-96	2003-04	
FAFH meal	0.400**	0.550**	-46.007*	-29.850	1.853***	0.796	+
	(0.193)	(0.216)	(23.575)	(23.754)	(0.365)	(0.499)	
FFS meal	0.347*	0.456	-79.741**	-38.321*	0.628	0.987	
	(0.183)	(0.325)	(35.211)	(21.720)	(0.478)	(0.920)	
100 grams of CSB	-0.138***	-0.079**	-12.108***	-14.688***	0.957***	0.917***	
	(0.026)	(0.029)	(4.230)	(3.189)	(0.070)	(0.132)	
R-squared	0.04	0.03	0.03	0.04	0.17	0.23	
Gap between FFS and FAFH	0.054	0.094	33.735	8.472	1.225**	-0.191	+

FAFH = food away from home: FFS = food from school (includes all foods obtained at schoo)l: N=1,608. CSB = caloric sweetened beverages. HEI = Healthy Eating Index. Standard errors in parentheses; *** significant at 1 percent, ** significant at 5 percent, * significant at 10 percent; +++ difference between 1994-96 and 2003-04 is significant at 1 percent; ++ difference between 1994-96 is significant at 5 percent, + difference between 1994-96 is significant at 10 percent; additional controls include whether the respondent ate breakfast, lunch, dinner, or a snack each day and whether the recall day was on a weekend; survey weights and complex design incorporated using svy command in Stata 10.1.

Source: USDA, Economic Research Service.

Table 8

Effects of FAFH and FFS on total calories, HEI-2005, and component densities of children ages 13-18

	Energy		Total HEI score		Total fruit		Whole fruit	
	1994-96	2003-04	1994-96	2003-04	1994-96	2003-04	1994-96	2003-04
FAFH meal	56.964	151.078***	-2.367***	-1.741**	-0.015	-0.065**	-0.017	-0.059**
	(45.367)	(43.520)	(0.453)	(0.673)	(0.029)	(0.027)	(0.019)	(0.021)
FFS meal	171.836**	119.566**	-0.499	-2.722*** +	-0.063	-0.092**	-0.009	0.006
	(75.611)	(51.902)	(0.923)	(0.714)	(0.055)	(0.036)	(0.026)	(0.020)
100 grams of CSB	36.860***	34.187***	-0.368***	-0.442***	-0.020***	-0.018***	-0.009***	-0.003 +
	(5.129)	(6.209)	(0.060)	(0.056)	(0.004)	(0.004)	(0.003)	(0.002)
R-squared	0.18	0.20	0.09	0.10	0.03	0.05	0.01	0.02
Gap between FFS and FAFH	-114.872	31.512	-1.867*	0.980	0.048	0.027	-0.008	-0.065*

	Whole grains		Dairy		All vegetables		Dark-green vegetables	
	1994-96	2003-04	1994-96	2003-04	1994-96	2003-04	1994-96	2003-04
FAFH meal	-0.027	-0.027	0.005	0.018	-0.080**	-0.077**	-0.035***	-0.028***
	(0.020)	(0.021)	(0.020)	(0.043)	(0.034)	(0.032)	(0.006)	(0.006)
FFS meal	-0.061*	-0.068	0.127***	0.220***	0.035	0.042	-0.020	-0.028***
	(0.035)	(0.039)	(0.044)	(0.069)	(0.039)	(0.067)	(0.013)	(0.009)
100 grams of CSB	-0.002	-0.004	-0.031***	-0.024***	-0.004	0.003	-0.001	-0.000
	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.001)	(0.001)
R-squared	0.02	0.04	0.12	0.09	0.03	0.04	0.03	0.02
Gap between FFS and FAFH	0.034	0.041	-0.122**	-0.203***	-0.115**	-0.118*	-0.015	0.000

	Percent saturated fat		Sodium		Extra calories	
	1994-96	2003-04	1994-96	2003-04	1994-96	2003-04
FAFH meal	0.464***	0.503*	-65.874**	-36.513	2.399***	1.043* +
	(0.157)	(0.262)	(25.961)	(39.543)	(0.477)	(0.506)
FFS meal	0.697**	0.780***	21.843	14.003	0.620	2.077*** +
	(0.308)	(0.264)	(35.301)	(53.752)	(0.776)	(0.316)
100 grams of CSB	-0.125***	-0.119***	-14.699***	-11.085***	0.751***	0.690***
	(0.021)	(0.026)	(2.316)	(3.249)	(0.058)	(0.057)
R-squared	0.06	0.06	0.05	0.05	0.24	0.21

FAFH = food away from home: FFS = food from school (includes all foods obtained at school): N=1,082. CSB = caloric sweetened beverages. HEI = Healthy Eating Index. Standard errors in parentheses; *** significant at 1 percent, ** significant at 5 percent, * significant at 10 percent; + indicates the difference between the two time periods is significant at 10 percent; additional controls include whether the respondent ate breakfast, lunch, dinner, or a snack each day and whether the recall day was on a weekend; survey weights and complex design incorporated using svy command in Stata 10.1.

Source: USDA, Economic Research Service.

Discussion and Policy Implications

This study's findings support the contention that increased consumption of FAFH is a contributing factor in the current epidemic of childhood obesity. Compared with foods prepared at home, FAFH is associated with increased caloric intake and lower diet quality, especially among older children. These effects are found after employing a methodology that controls for underlying personal characteristics and circumstances, such as access to food outlets, which might affect intake. This strengthens the argument that there is a causal relationship between FAFH and increased caloric consumption and decreased dietary quality. These findings also support policy and educational efforts designed to help children and their parents make more informed food and beverage choices when eating away from home.

One of the most common choices when eating away from home is consumption of caloric sweetened beverages. Our analysis finds that much, but not all, of the adverse dietary effect of FAFH is driven by its association with increased consumption of CSBs. The effect of CSB consumption on caloric intake is particularly striking: each calorie consumed from CSBs adds almost 1 additional calorie to overall daily intake. CSB consumption also lowers diet quality, reducing the overall share of calories of healthful foods, such as fruits, whole grains, and milk. The addition of calories lacking in any food components other than added sugar will tend to decrease density. CSBs may also displace consumption of more healthful beverages, such as milk and fruit juice, which may explain reductions in the densities of milk and total fruit components in the diets of children. Efforts to reduce children's consumption of CSBs include restrictions on the availability of these beverages at schools and other locations primarily serving children, such as community recreation centers (IOM, 2009), and nutrition education efforts. Some fast food and other restaurants have begun offering milk or juice as beverages with children's meals. Taxes on CSBs have also been proposed as a strategy for limiting general consumption (Brownell and Frieden, 2009; Chaloupka et al., 2009; IOM, 2005). The relative effectiveness of these approaches deserves further investigation.

Findings on the nutritional effects of food obtained at school reveal striking differences by age group. Among younger children, FFS does not add to caloric intake or decrease diet quality. Among older children, the adverse effects of FFS on the diets are similar to those of other FAFH, in that each adds similar amounts of calories to the daily diet. This likely reflects the prevalence of low-nutrient, high-energy competitive foods available as snacks in middle and high schools (Fox et al., 2009). These are foods sold outside the regular school lunch and breakfast program, which follow guidelines set by USDA. FFS has a somewhat less negative effect than other FAFH on overall diet quality for this age group,

Although these findings do not support arguments that food obtained from school contributes to the obesity epidemic, neither does it show that school food leads to improvement in the many areas in which the diets of American children are lacking. Overall, American children eat too few fruits, dark-green and orange vegetables, and whole grains. Given the considerable Federal investment in school meal programs, it is reasonable to investigate how school food can do more to address these shortfalls. The recent IOM

report *School Meals: Building Blocks for Healthy Children* proposes new Federal meal standards that would require meals to serve more of these underconsumed dietary components. USDA Secretary Thomas Vilsack has announced his intention to transform these recommendations into updated Federal regulations (USDA, 2009); such actions may have positive impacts on FFS quality. USDA has legislative authority to regulate foods sold as part of the reimbursable meal, so any updates to the current Federal regulations will not apply to many of the other foods that compete for students' attention, such as the a la carte items also sold in school cafeterias.

In general, our findings suggest that consumption of food prepared outside the home has particularly negative effects on the diets of older children and adolescents. Foods available to these children from both commercial and school sources add calories and decrease diet quality. Moreover, older children eat more nonhome foods: on average they eat 50 percent more FAFH meals and twice as many FAFH snacks as younger children. Older children and adolescents typically have more freedom, more time with peers, more spending money of their own, and, therefore, more opportunities to make their own food choices, at school and elsewhere, than younger children. Unfortunately, older children are opting for less healthful and nutritious foods.

Several of the most widely discussed proposals for improving children's diets, such as improving the nutritional quality of "children's meals" sold at fast food and other restaurants or restricting food advertising for television programs watched by children under age 12, are targeted to younger children and would have little or no effect on older children and adolescents. More investigation of appropriate and effective strategies targeting this older age group seems warranted. Devising such strategies, however, may be a challenge; during adolescence, peer influences on behavior, including food choice, are strong and may trump nutrition advice (Stang and Story, 2005). Nevertheless, given the importance of this stage to an individual's growth, development, and formation of longer term habits (Kelder et al., 1994), it merits more consideration.

A broad range of public and private groups have expressed a strong interest in improving children's diets. Many of the proposed policy and educational efforts aimed at improving child nutrition and preventing obesity focus on food obtained from fast food and other restaurant and commercial sources, foods obtained at school, and caloric sweetened beverages. Findings in this study point to the importance of these areas of policy focus and provide insights that can help inform selection and design of nutrition policies and strategies.

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